BUFFALO NATIONAL RIVER

WATER QUALITY

REPORT

1985

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Resource Management Specialist

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INTRODUCTION

In 1985, Buffalo National River implemented a water quality monitoring program. This program was based on a plan formulated in conjunction with the NPS Water Resources Field Support Laboratory in February of that same year. The program consisted of three basic monitoring categories: 1. River Corridor sites (Trend Monitoring) 2. Tributary sites (Reconnaissance) 3. Primary Contact Recreation sites (Public Health).

The program was intended to establish a consistent set of river corridor monitoring sites for which data would be gathered on a scheduled frequency, to be continued from year to year. This data could then be used to detect general trends or changes in water quality of the river over an extended period of time. Such a program is desperately needed at Buffalo National River because data collected in the past has never been collected in a consistent enough manner to compare from year to year in order to asses such changes or trends. This has left the National Park Service few tools with which to gauge what is happening to a major resource (the waters of Buffalo River).

Another purpose of the program was to gather water quality data for the river's major tributaries. This data, collected on a more intensive schedule than the river corridor data (but for only one monitoring season), could then be used to determine the relative condition of these tributaries, the source(s) of any problems detected in the river channel, and where future tributary monitoring efforts should be concentrated.

The third monitoring category was that of Primary Contact Recreation Sites (swimming holes and heavily canoed sections). The purpose of this monitoring was to assure that water quality standards established to protect public health, were not being exceeded.

RESULTS

In general, there appear to be no significant differences in water quality variables measured in this program as compared to data from the "Ecosystems" reports published between 1973 and 1978. It is however, somewhat difficult to compare these data since, as was previously mentioned, most data in the past have been collected on a "one-shot" basis which makes it highly susceptible to atypical hydrologic conditions.

The same general patterns as described by Nix et.al (Ecosystems 1973) were seen in the 1985 data i.e., a gradual increase in specific conductivity values in the downstream direction, generally higher specific conductivity values for tributaries as compared to their mainstream confluences and the river corridor as a whole and a typical seasonal variation in specific conductivity and dissolved oxygen values. In addition, mean values for fecal coliform in the tributaries were generally higher than those for the river corridor. This may be due simply to the closer proximity of the tributaries to agricultural and domestic runoff and the cumulative effects of dilution coupled with bacteria die off in the river corridor.

Little deviation was evidenced in median fecal coliform values for all river and tributary sites combined which would seem to indicate that there was no major input of bacterial pollution from any point sources or concentrated nonpoint sources.

There were a few noticeable anomalies in the data. Slightly higher fecal coliform values and slightly lower specific conductivity values in Beech Creek are probably due mostly to the small number of samples that were taken (Beech Creek is one of the first to go dry in dry weather), and the hydrologic conditions at the time of these samples. Most of the Beech Creek samples were taken during fairly wet periods when greater runoff was occurring (two of six were taken following an intense storm event). This would account both for the lower specific conductivity and the higher fecal coliform values. However, this trend was also noticed in the Boxley Valley water quality project (Nix et.al. 1985) and deserves further monitoring and study in the future.

The same trends (lower specific conductivity and higher fecal coliform values) were also noted in Richland Creek. Atypically low conductivity levels in Richland Creek have been noted in the past (Buffalo National River Ecosystems) and have been attributed to the geologic characteristics of the Richland Creek watershed which lies more in sandstone and shale and less in the Boone limestone than most others. Higher fecal coliform levels might be explained by the greater concentration of grazing activity and amount of direct livestock access to the stream, both in close proximity to Richland's confluence.

Slightly higher fecal coliform levels were found in Bear Creek. This may have been due in part, to the same factors discussed for Beech Creek. Several samples were missed when flow dried up in midsummer, and one sample was taken just as a storm event began to cause runoff. These factors combined may account for these slightly higher mean values.

Slightly elevated specific conductivity levels were recorded for Clabber Creek. The reason for these higher levels is not clear. While these values were only slightly higher than those for several other tributaries, they do warrant further monitoring and study.

Slightly higher fecal coliform levels were recorded for Middle Creek. However, the sample size for all tributaries in the Lower Buffalo Wilderness Area was very small making it difficult to compare with other data.

Data collected at Primary Contact Recreation (Public Use) sites were all similar to those collected for river corridor sites. Conductivity values were typical. Fecal coliform levels were average to low with most in the range of zero to 20 colonies per 100 ml, and no samples exceeding 200 colonies per 100 ml. Based on this data, it would probably be adequate to monitor these sites on a reduced schedule, sampling only when the heaviest visitor use is actually occurring.

Samples were collected from various springs along the river as time and scheduling permitted. These data, although samples and locations were not regular enough to make detailed comparisons, showed much higher specific conductivity levels and generally higher fecal coliform levels than those of surface water. Sampled springs showed without exception, extremely high fecal coliform levels for several hours or days following heavy rainfall in the area. One sample from Gilbert Spring after a very heavy but local rain, contained over 1000 colonies per 100 ml. These trends are what might be expected and have been previously documented (Aley 1981). Conductivity is generally higher due to a springs' extended time of contact with limestone formations resulting in a higher concentration of dissolved solids. Fecal coliform levels are higher because of the lack of filtration in karst systems and the lack of exposure to sunshine's ultraviolet rays. These same general trends were observed in samples from the stream inside Fitton Cave although fecal coliform levels were quite low (less than 4 colonies per 100 ml) possibly because samples were collected at low flow.

Several sets of samples were collected from selected sites in Boxley Valley during 1985. This was done primarily to compliment data from other samples collected under the study contracted to Nix and Thornton (1985) in Boxley Valley. Extremely high fecal coliform values (7000+ colonies per 100 ml) were found in the LuAllen spring stream and in the Mill Pond spring stream. These high levels are easily attributable to very concentrated livestock use in and around the stream and the sustained flow in these streams during low flow periods. Summaries of these data sets are in the water quality data files.

Samples were collected at 17 sites in the Boxley/Ponca area immediately following a very heavy (3.5 inches), localized storm. These data, as would be expected, show atypically low specific conductivity levels and extremely high (1000+ colonies per 100 ml) fecal coliform levels as the river begins to rise, with fecal coliform levels declining rapidly within a few hours.

RECOMMENDATIONS

As a minimum, sampling at the River Corridor sites as outlined in the Water Quality Monitoring Plan (Feb. 1985), should be continued on a year to year basis in order to maintain a consistent data base to which each years data may be compared.

Any tributary monitoring activities should be concentrated on those tributaries which 1985 data indicates may be warranted, and on those tributaries for which no data was collected in 1985 that have a reasonable potential for water quality problems. Other activities should include limited monitoring at primary public use sites, additional storm event and spring monitoring, and limited monitoring in those areas such as Boxley, Erbie, Buffalo Point (sewage treatment plants), and other areas where NPS management actions may affect water quality.

WATER QUALITY MONITORING SITE LOCATION

KEY

RIVER CORRIDOR SITES

R1	Boxley
R2	Ponca
R3	Pruitt
R4	Hasty
R5	Woolum
R6	Gilbert
R7	Highway 14 Bridge
R8	Rush
R9	River Mouth

TRIBUTARY SITES

T1	Beech Creek
T2	Ponca Creek
T3	Cecil Creek
T4	Mill Creek (near Pruitt)
T5	Little Buffalo River
T6	Big Creek (near Carver)
T7	Davis Creek
T8	Cave Creek
T9	Richland Creek
T10	Calf Creek
T11	Mill Creek (near St. Joe)
T12	Bear Creek
T13	Brush Creek (near Morning Star)
T14	Tomahawk Creek
T15	Water Creek
T16	Rush Creek
T17	Clabber Creek
T18	Big Creek (near Big Flat)
T19	Cedar Creek
T20	Cabin Creek
T21	Boat Creek
T22	Brush Creek (Lower Buffalo Wilderness Area)
T23	Middle Creek
T24	Leatherwood Creek (Lower Buff. Wild. Area)
T25	Cow Creek
T26	Stewart Creek
T27	Cook Creek

Table 1

PUBLIC USE SITES

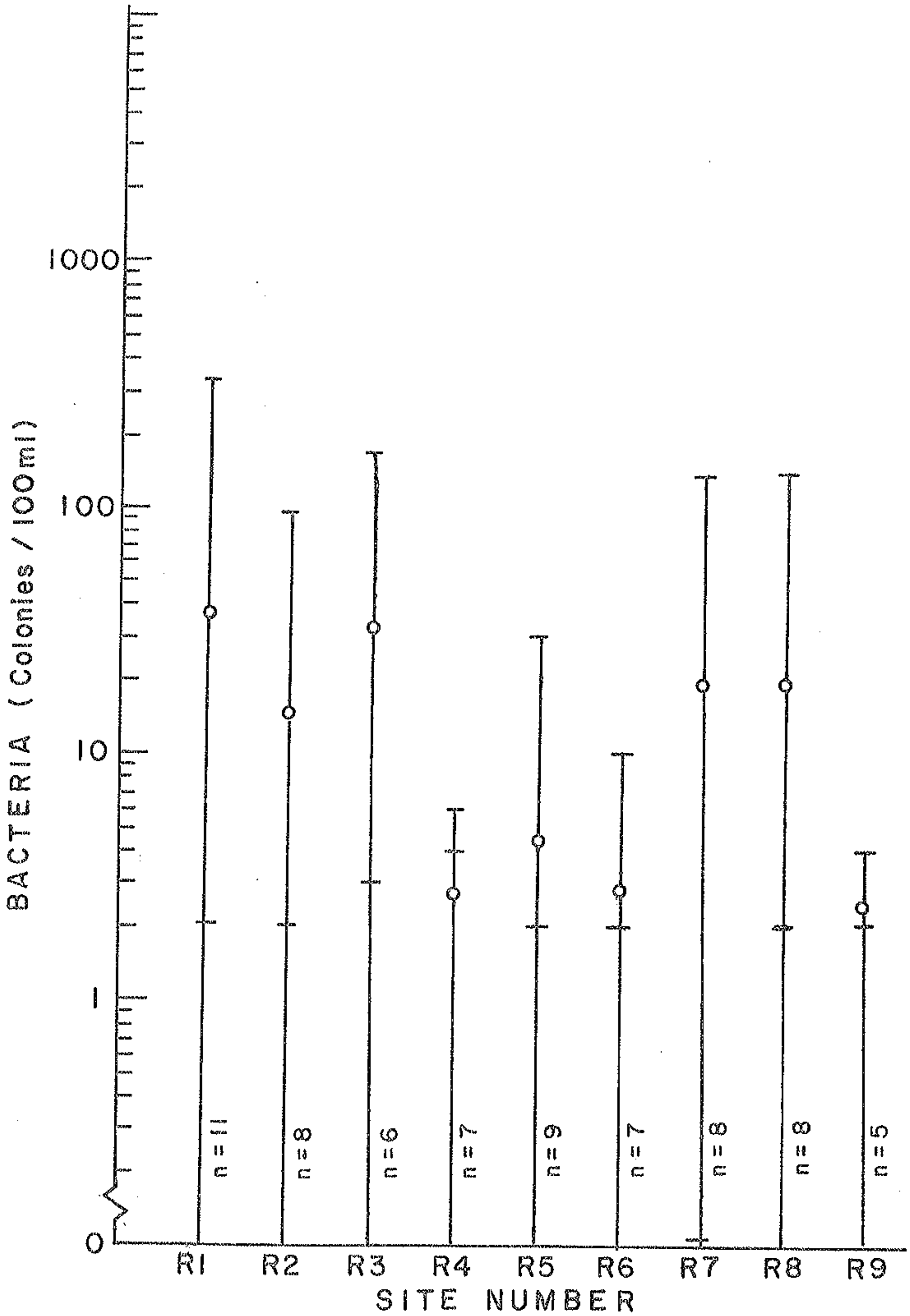
Ponca Low Water Bridge	Highway 65 Bridge
Steel Crk. Swimming Area	Gilbert
Steel Crk. Lower Launch	Buffalo Point Launch/Swim Area
Kyles Launch Area	Buffalo Point / E Loop
Pruitt Day Use Area	Rush Landing
Pruitt Launch Area	

SPRINGS

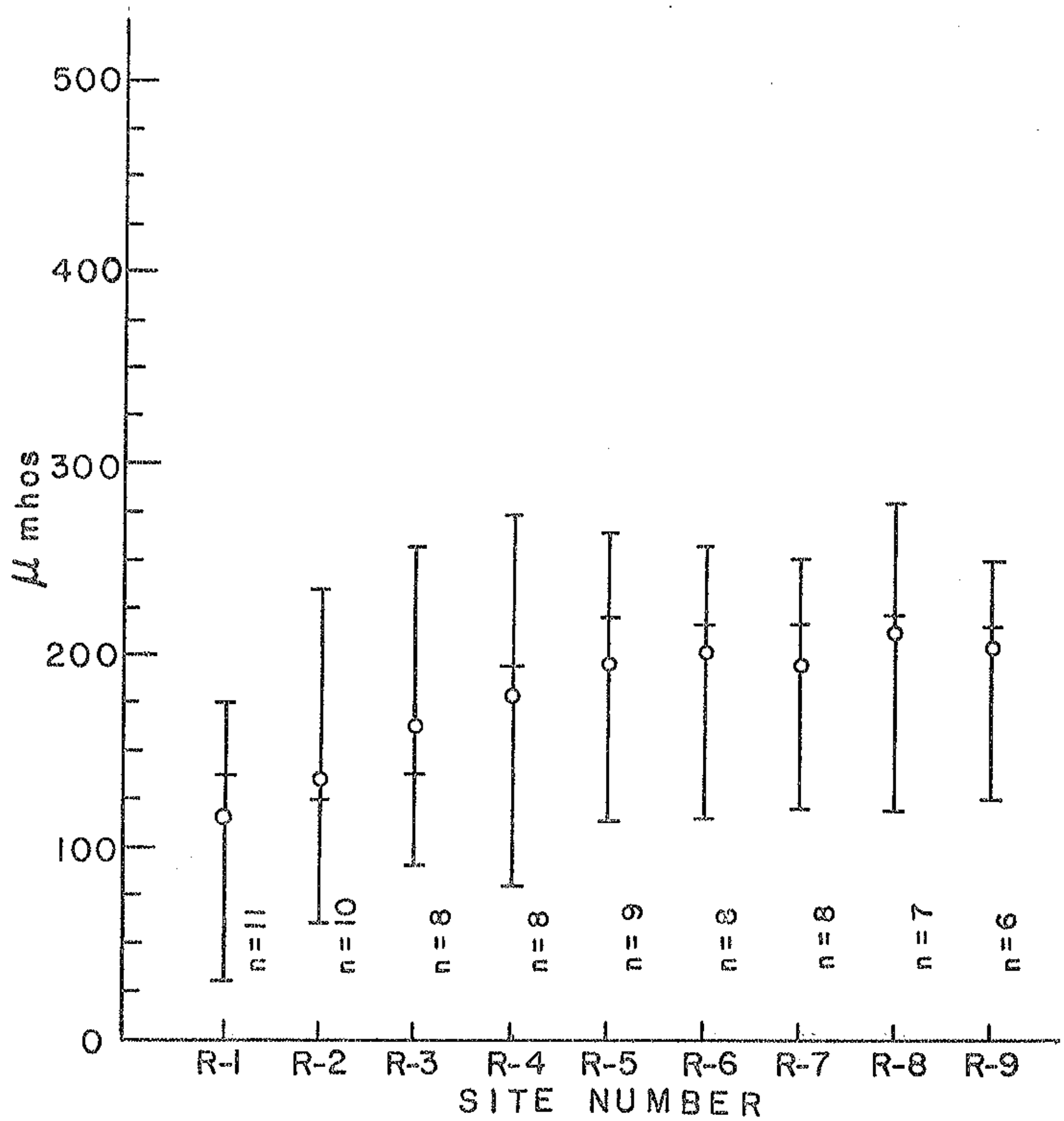
LuAllen Spring	LuAllen Spring #2
Edgemon Spring	Hwy. 43 Spring
Lost Valley Spring	Steel Creek Research Center Spring
Fuller Spring	Hamilton Spring
Mitch Hill Spring	Gilbert Spring
Fitton Cave	

Table 2

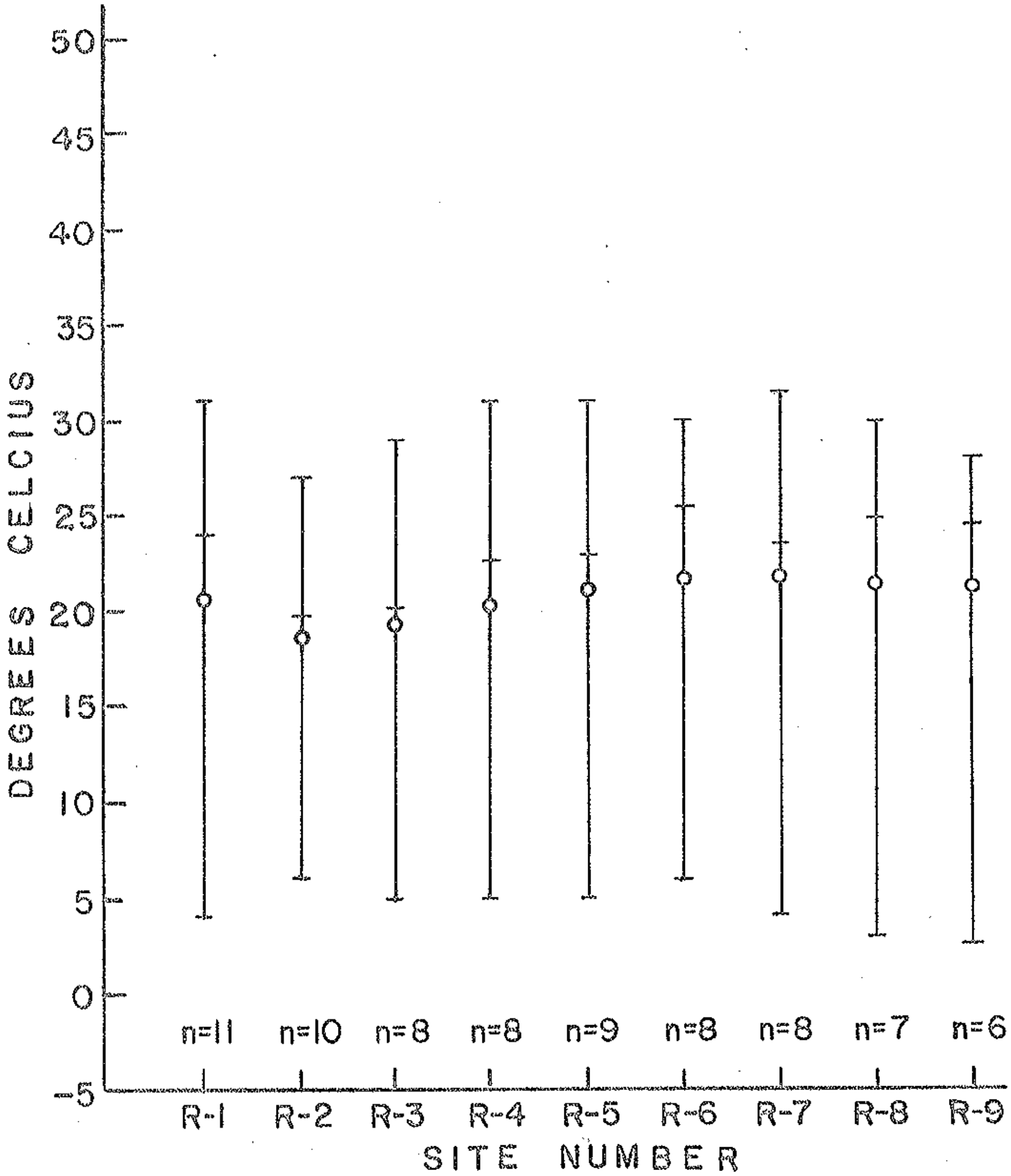
FIGURES



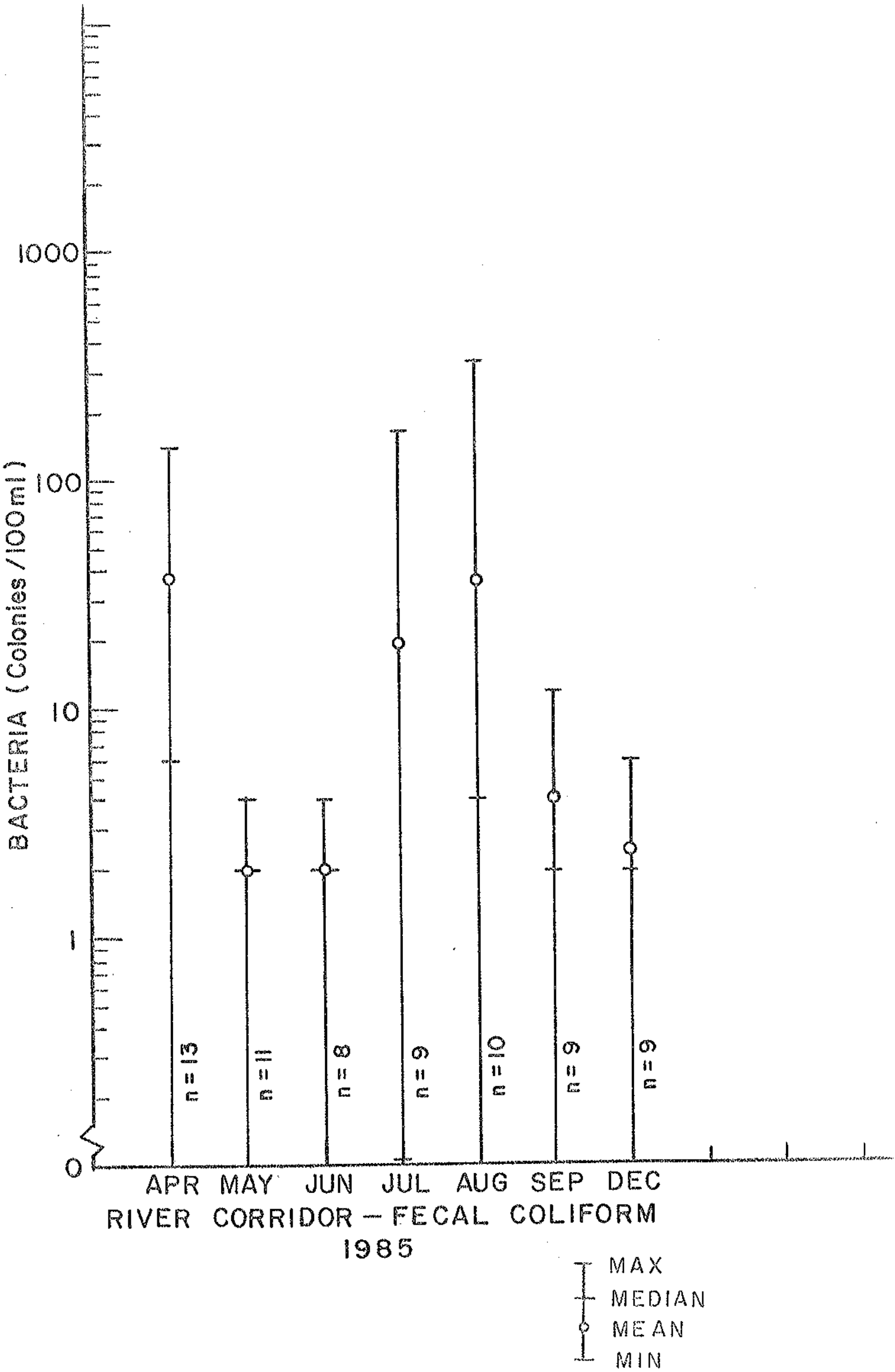
RIVER CORRIDOR — FECAL COLIFORM
1985



RIVER CORRIDOR — SPECIFIC CONDUCTIVITY
1985



RIVER CORRIDOR — TEMPERATURE
1985



RIVER CORRIDOR — FECAL COLIFORM
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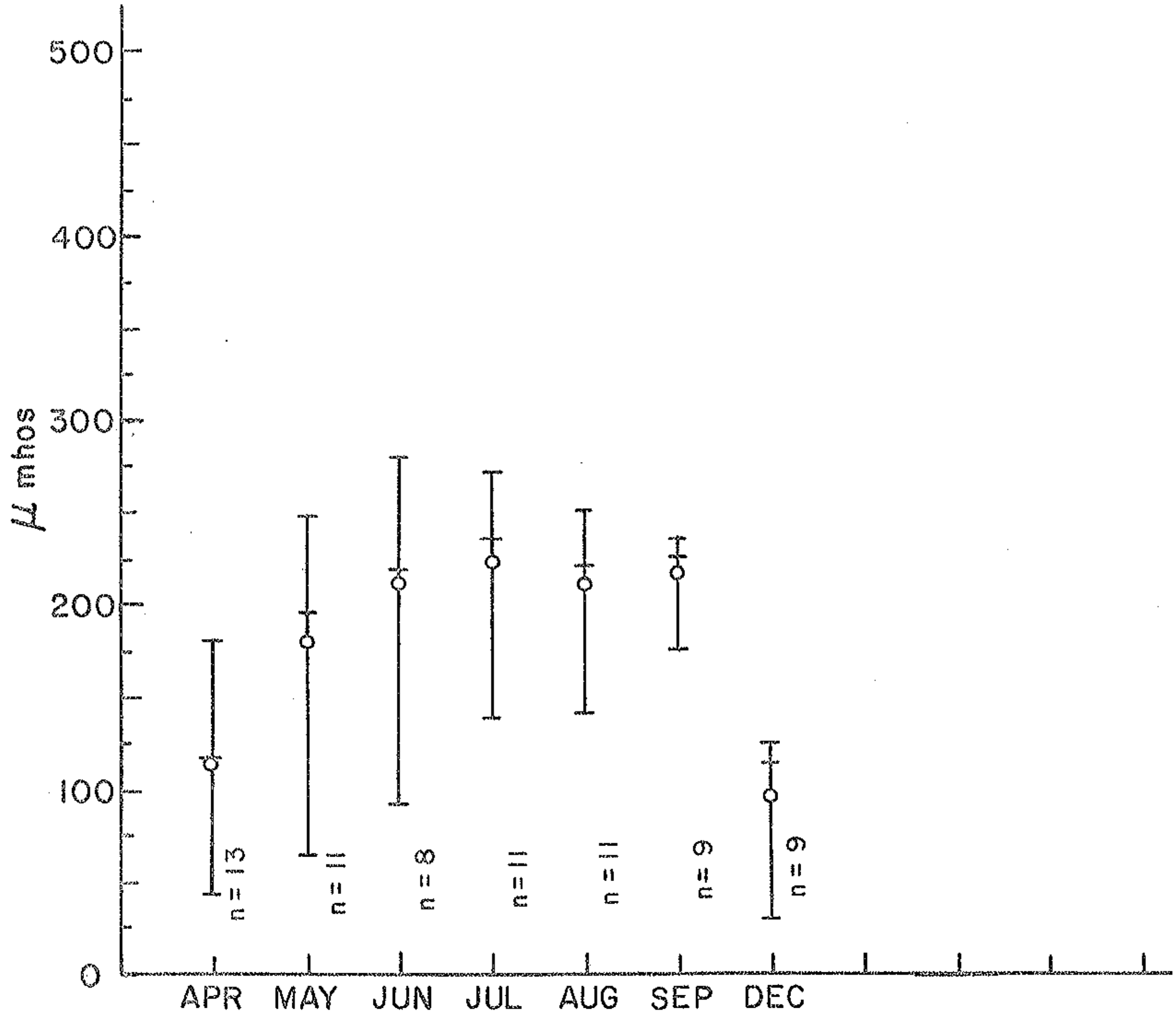
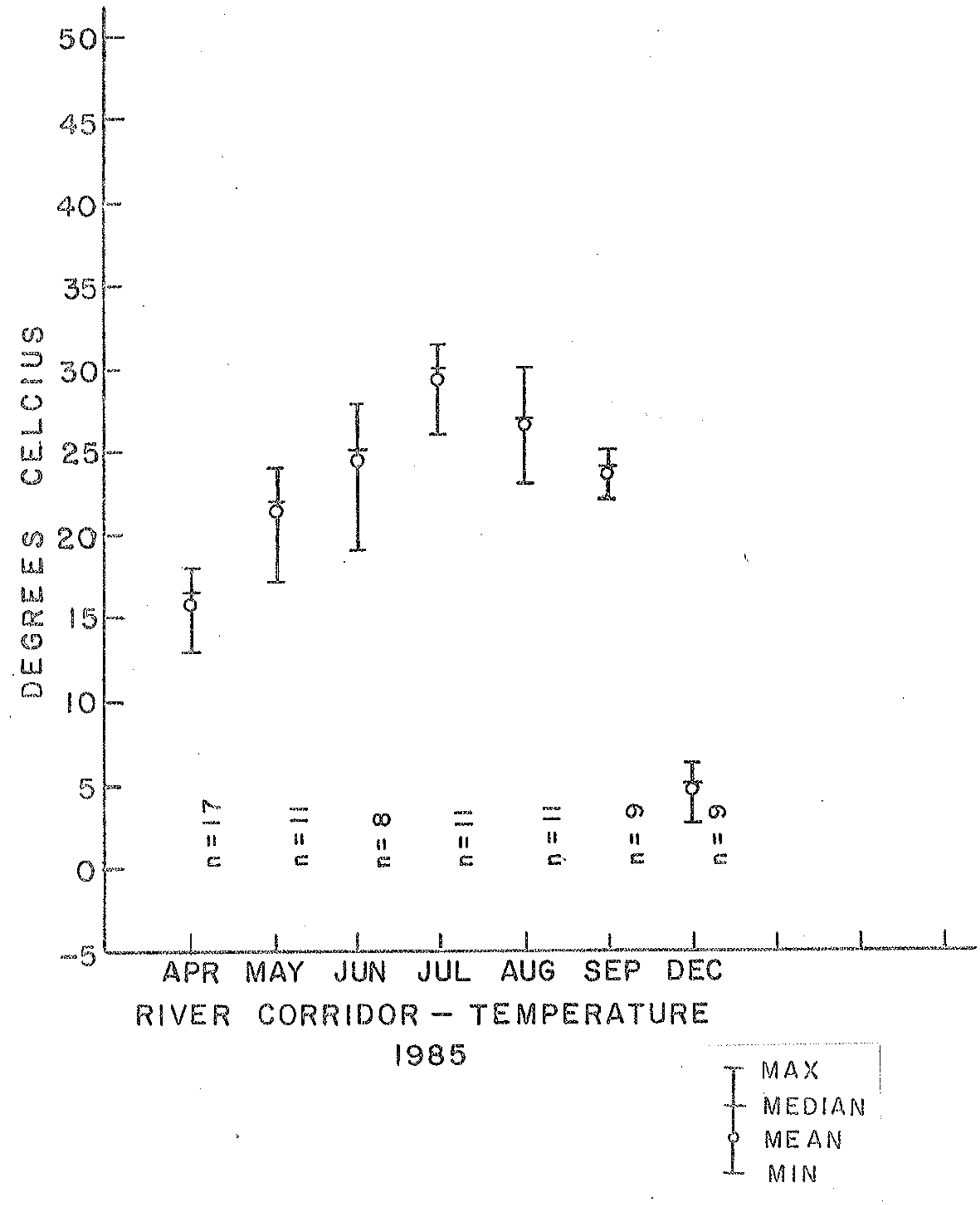
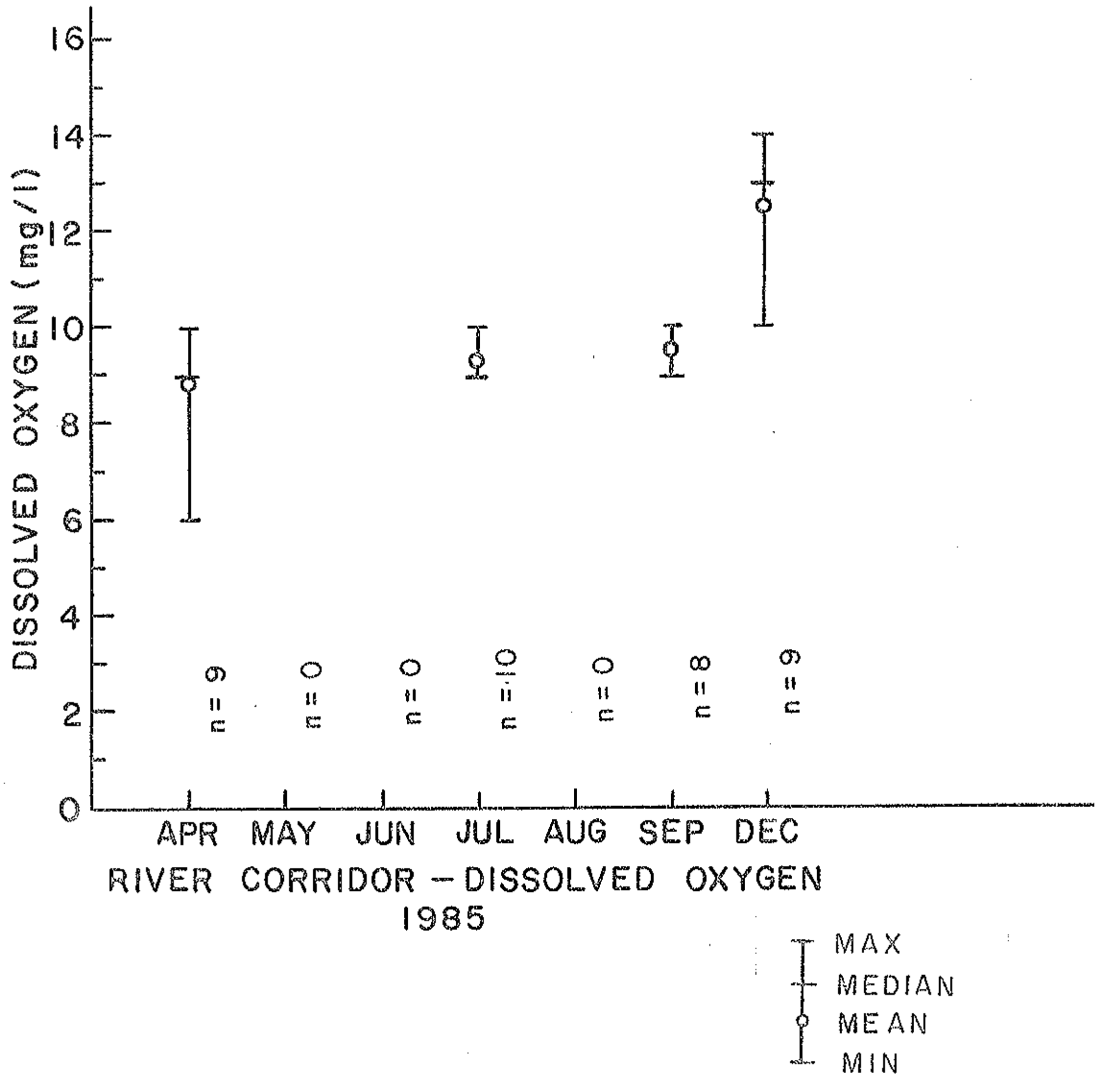


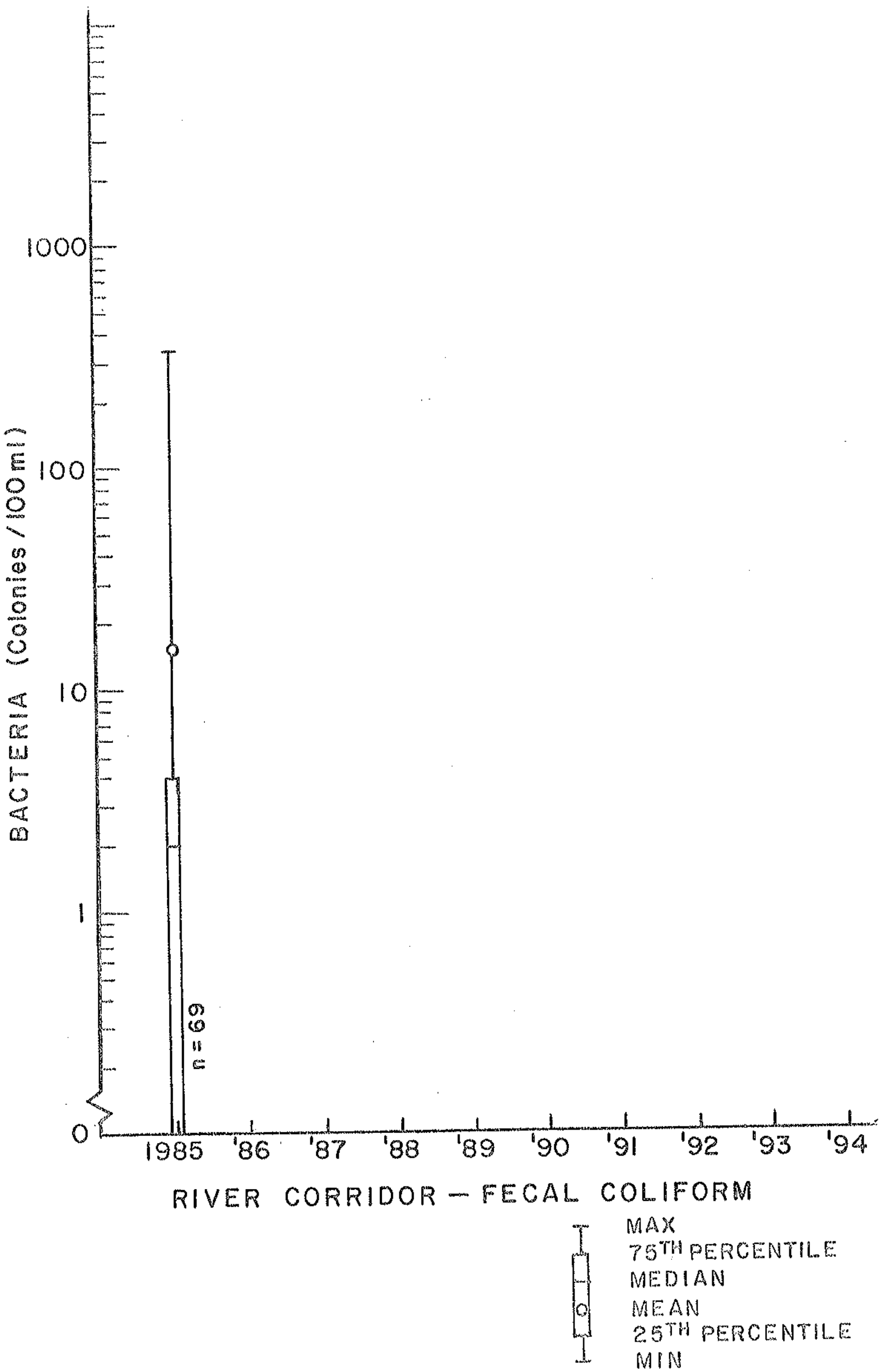
RIVER CORRIDOR - SPECIFIC CONDUCTIVITY
1985



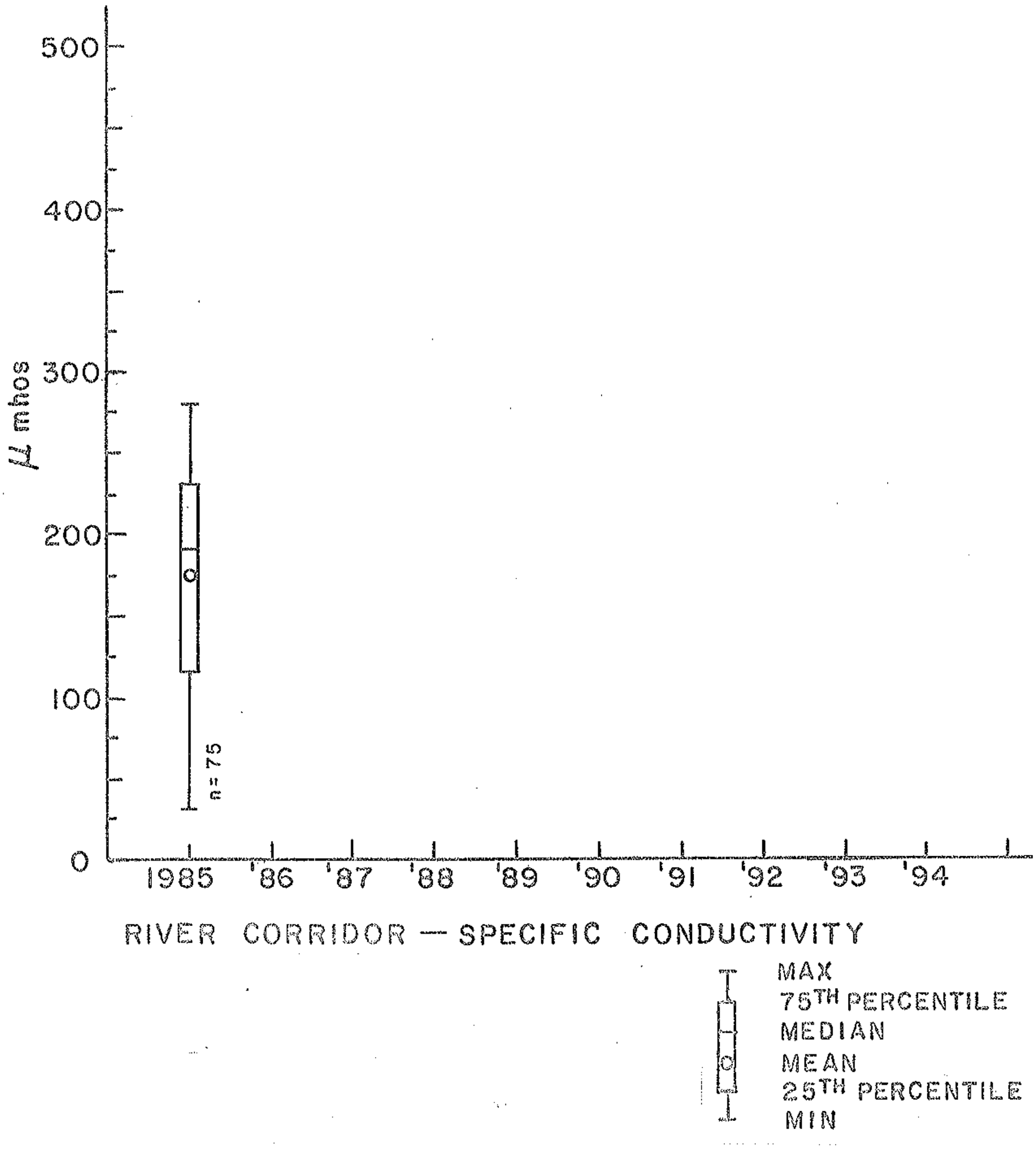
RIVER CORRIDOR — TEMPERATURE
1985

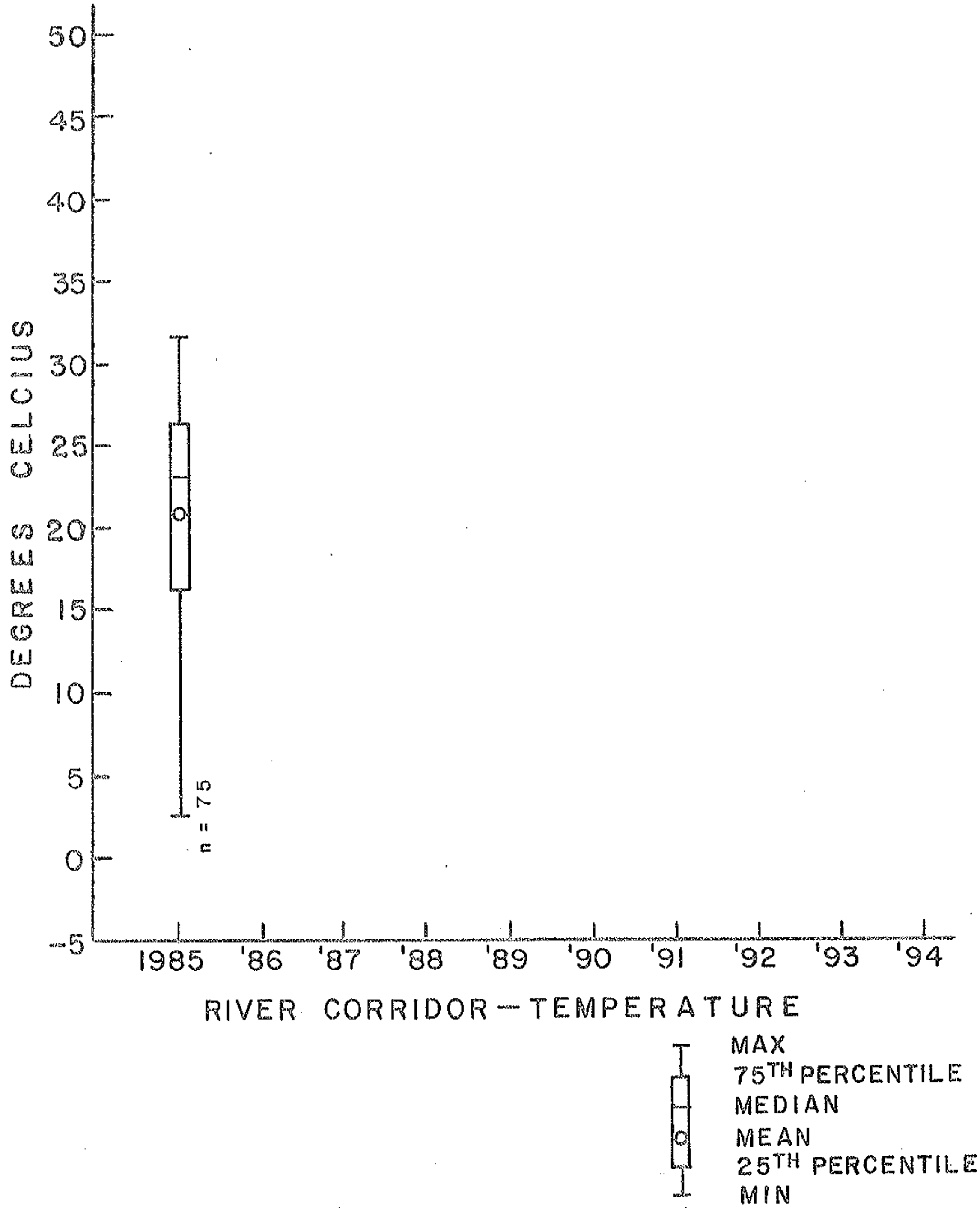


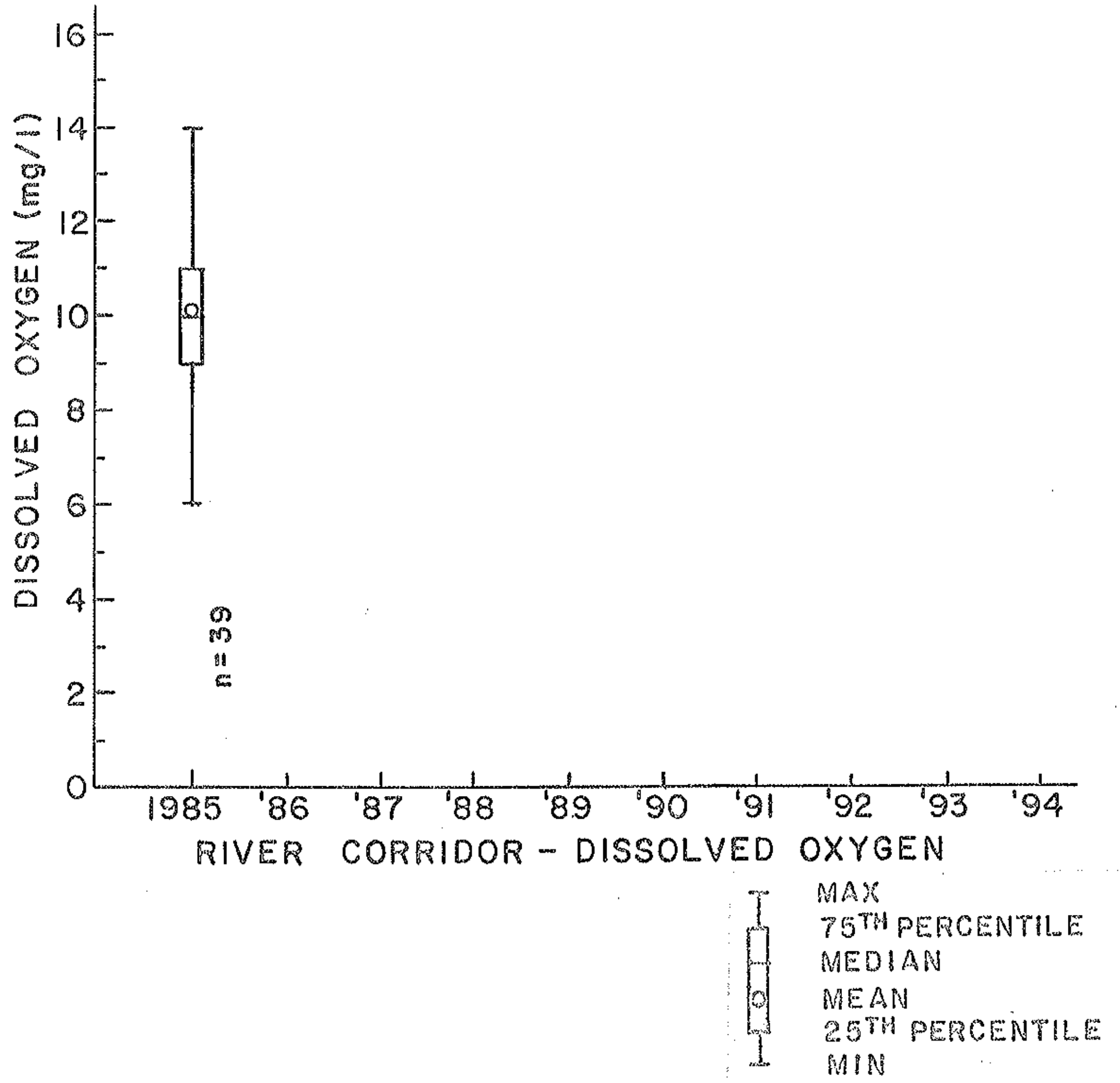
RIVER CORRIDOR – DISSOLVED OXYGEN
1985

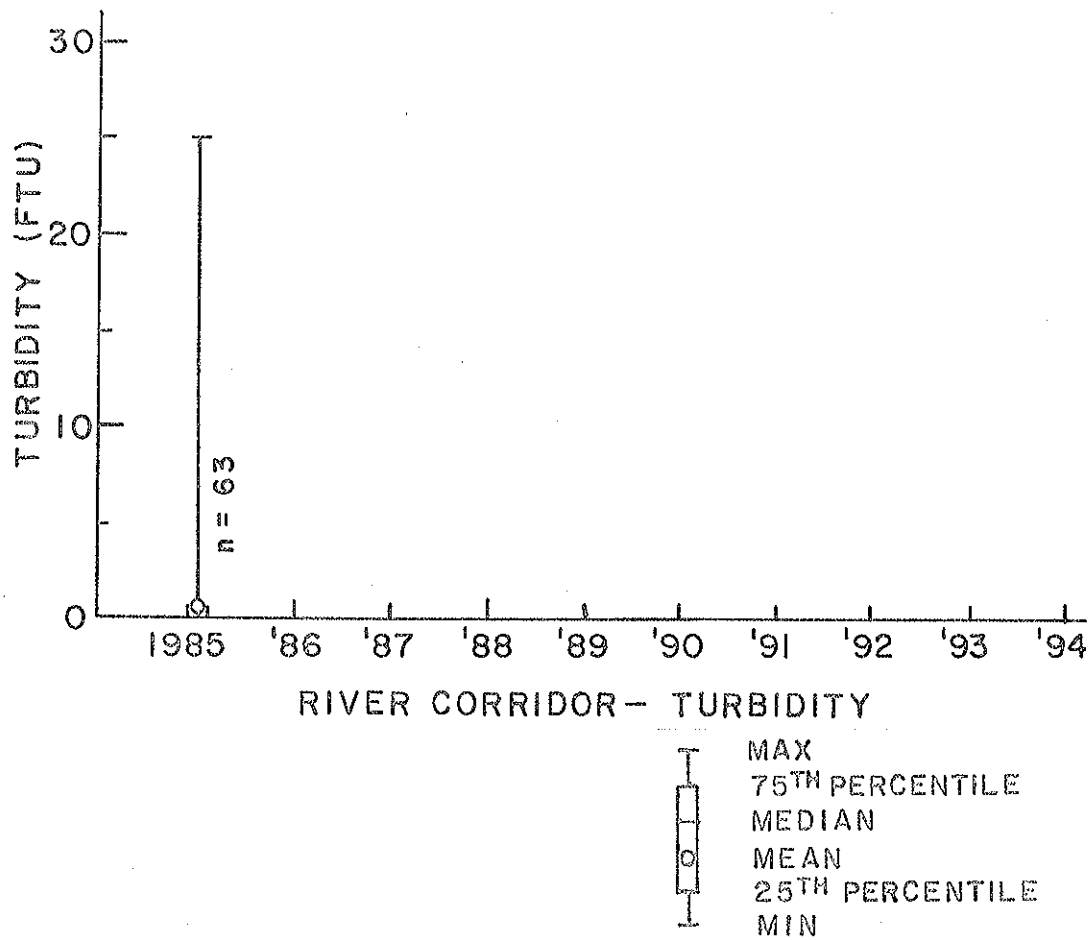


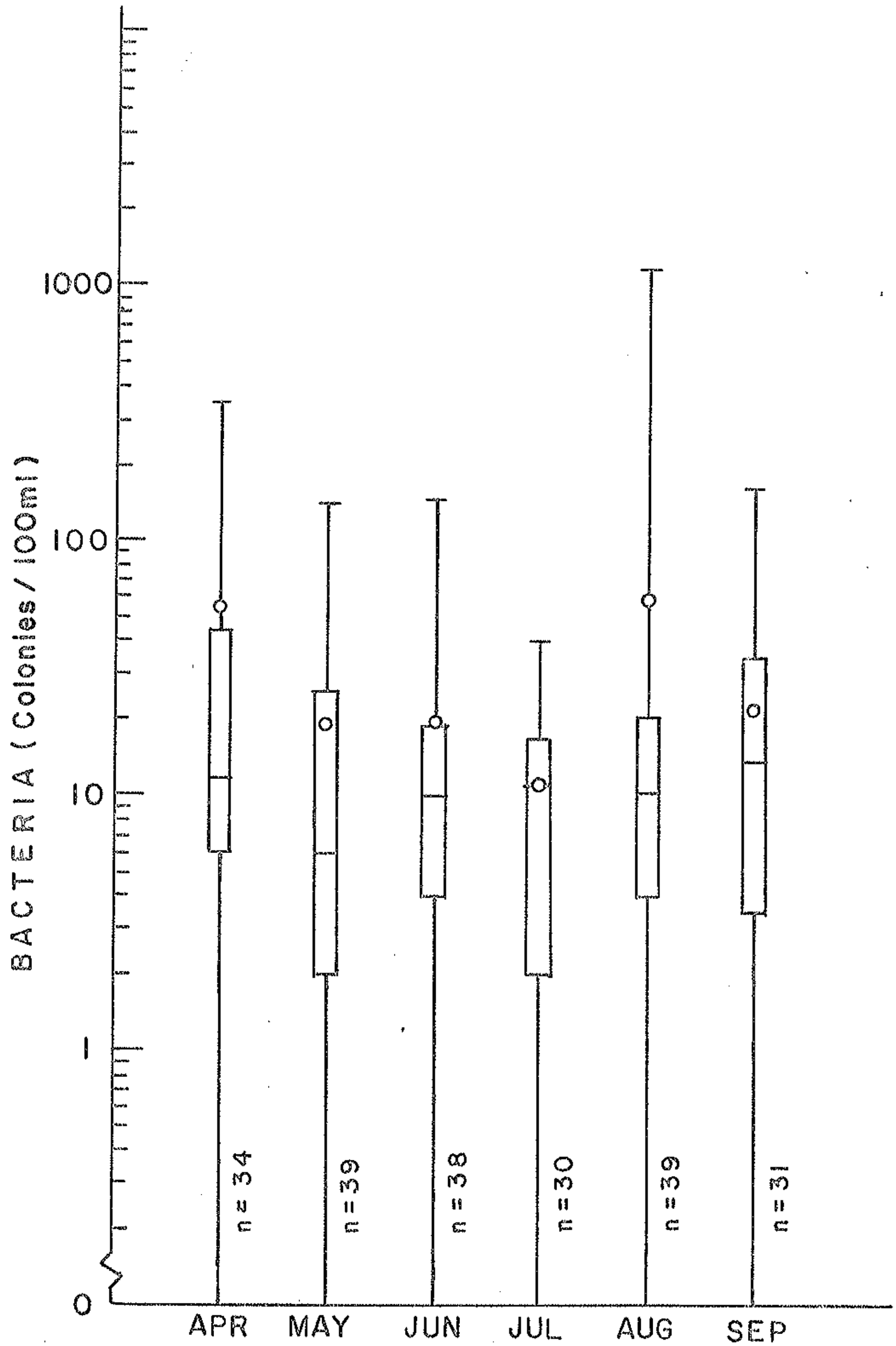
1000
100
10
1
0
BACTERIA (Colonies / 100 ml)
n = 69
1985
'86
'87
'88
'89
'90
'91
'92
'93
'94
RIVER CORRIDOR — FECAL COLIFORM
MAX
75TH PERCENTILE
MEDIAN
MEAN
25TH PERCENTILE
MIN


500
400
300
200
100
0
μ mhos
n = 75
1985
'86
'87
'88
'89
'90
'91
'92
'93
'94
RIVER CORRIDOR — SPECIFIC CONDUCTIVITY
MAX
75TH PERCENTILE
MEDIAN
MEAN
25TH PERCENTILE
MIN

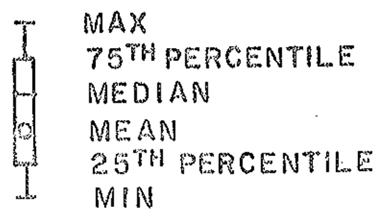

DEGREES CELCIUS
50
45
40
35
30
25
20
15
10
5
0
-5
n = 75
1985
'86
'87
'88
'89
'90
'91
'92
'93
'94
RIVER CORRIDOR — TEMPERATURE
MAX
75TH PERCENTILE
MEDIAN
MEAN
25TH PERCENTILE
MIN

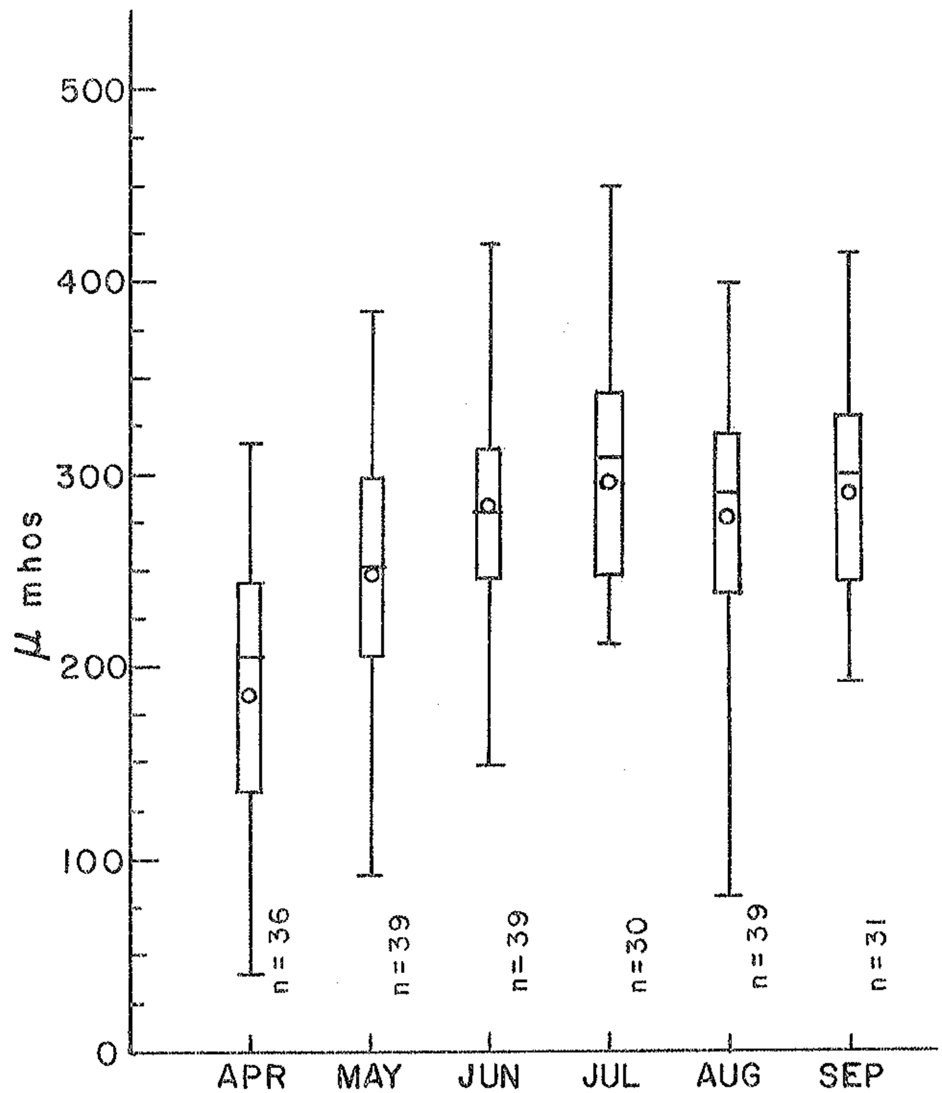

DISSOLVED OXYGEN (mg/l)
0
2
4
6
8
10
12
14
16
n=39
1985
'86
'87
'88
'89
'90
'91
'92
'93
'94
RIVER CORRIDOR - DISSOLVED OXYGEN
MAX
75TH PERCENTILE
MEDIAN
MEAN
25TH PERCENTILE
MIN


30
20
10
0
TURBIDITY (FTU)
n = 63
1985
'86
'87
'88
'89
'90
'91
'92
'93
'94
RIVER CORRIDOR— TURBIDITY
MAX
75TH PERCENTILE
MEDIAN
MEAN
25TH PERCENTILE
MIN

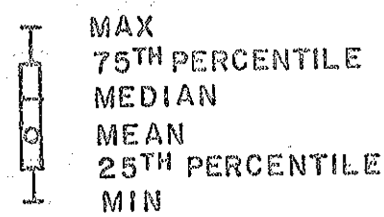


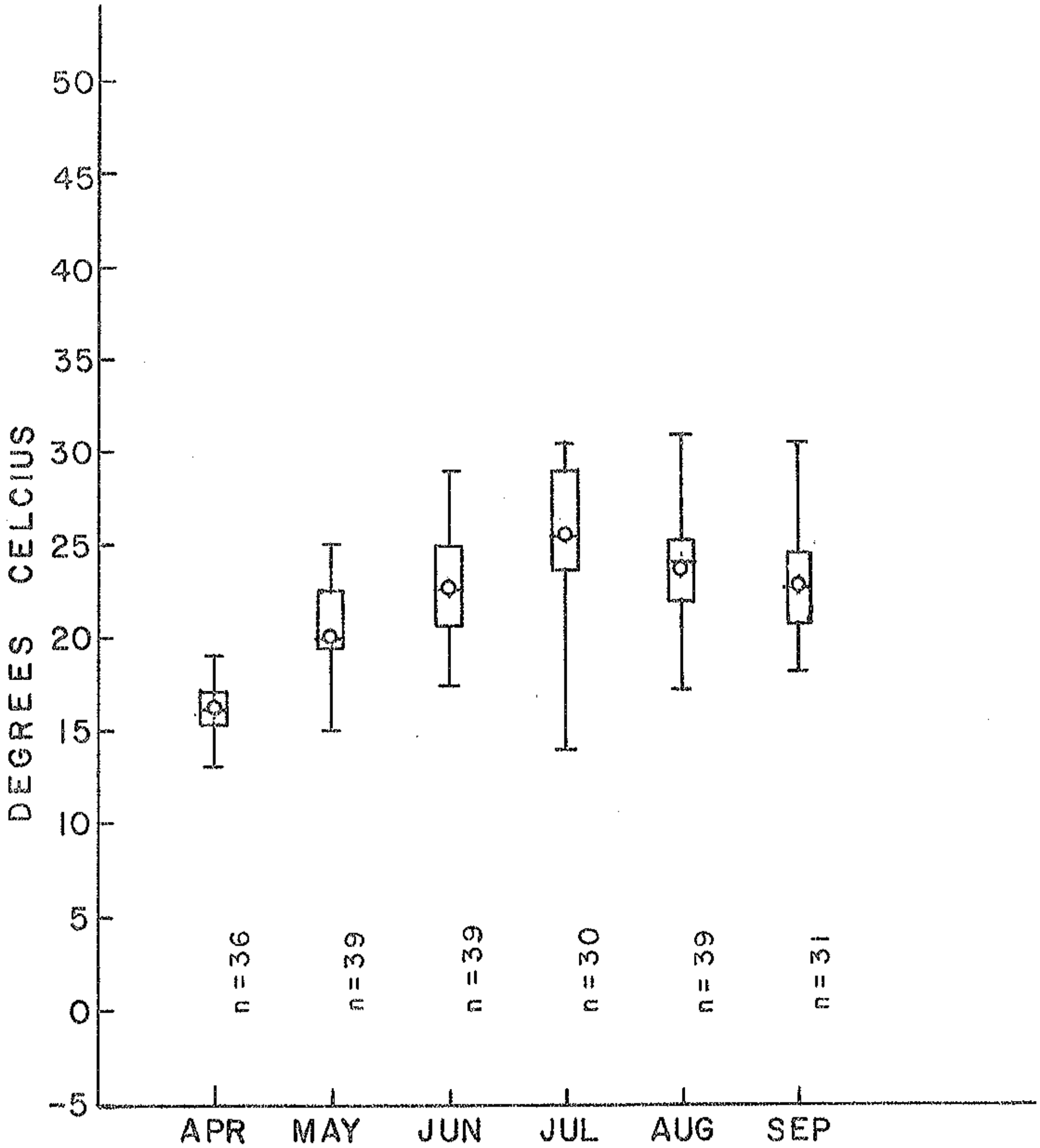
TRIBUTARY SITES — FECAL COLIFORM
1985



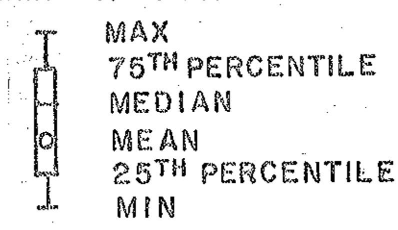


TRIBUTARY SITES— SPECIFIC CONDUCTIVITY
1985





TRIBUTARY SITES — TEMPERATURE
1985



APPENDIX A

SITE£	DATE	TEMP	SP/COND	TURB	D.O.	F/C
1R	850325	13	40		11	
1R	850408	13	43	5		2
1R	850423				6	52
1R	850515	17.1	64			4
1R	850614	19	91	0		2
1R	850701	26	138	0		2
1R	850709	30	159	0	10	0
1R	850720	30.1	170	0	10	0
1R	850805	24.2	141	25		338
1R	850824	26	165	0		0
1R	850921	24	175	0	9	4
1R	851221	4	30	0	12	6
2R	850325	13	60		11	
2R	850408	13.3	65	3		2
2R	850423	17.4	74	0	9	94
2R	850515	19.9	110			2
2R	850514	20	140	0		2
2R	850720	27	235	0	9	0
2R	850805	23	180	8		
2R	850824	26.9	205	0		12
2R	850921	22.2	225	0	9	12
2R	851221	6	60	0	13	2
3R	850325	14	100		11	
3R	850418	14	101	0		2
3R	850423	17.8	112	0	9	
3R	850515	23	167			0
3R	850824	27.1	235	0		2
3R	850921	22.5	235	0	9	10
3R	850720	29	258	0	9	174
3R	851221	5	90	0	14	4
4R	850515	22.5	190	0		4
4R	850423	16.9	80		8	
4R	850408	14	115	0		0
4R	850614	24	197	0		2
4R	850715	30.1	272	0	10	0
4R	850824	27	249	0		4
4R	850921	23	230	0		4
4R	851221	5	100	0	14	6
5R	850410	14.1	145	0		0
5R	850422				8	
5R	850425	18	124		10	30
5R	850513	23	220			2
5R	850517	21	208			4
5R	850612	25.1	225	0		2
5R	850719	31	263	0	9	0
5R	850821	28	252	0		0
5R	850922	25	225	0	10	2
5R	851221	5	114	0	14	0
6R	850412	15.2	152	0		10
6R	850424				9	
6R	850517	21	196	0		2
6R	850609	25.9	230	0		0
6R	850612	24	211	0		4
6R	850719	30	258	0	9	
6R	850825	27.5	230	0		4

6R	850922	25	222	0	11	0
6R	851221	6	115	0	13	0
7R	850412	17.1	170	0		6
7R	850425	18	125		10	145
7R	850517	21.9	218	0		0
7R	850609	27.8	250	0		0
7R	850723	31.5	235	0	9	0
7R	850825	29.9	229	0		0
7R	850920	25	215	0	9	2
7R	851220	4	120	0	10	0
8R	850412	16.5	180	0		2
8R	850425				10	145
8R	850517	22.9	222			2
8R	850609	25	280	0		4
8R	850723	30	242	0	9	0
8R	850825	28	221	0		4
8R	850920	25	232	0	9	0
8R	851220	3	120	0	12	0
9R	850519	24	248			0
9R	850618	26	210	0		2
9R	850723	28	235	0	9	
9R	850816	25	220	0		4
9R	850914	22	195	0	10	2
9R	851220	2.5	125	0	11	4

SITE£	DATE	TEMP	SP/COND	TURB	D.O.	F/C
1T	850408	13	50	2		0
1T	850423	15.8	40		9	32
1T	850515	20	100			6
1T	850528	19.9	92	0		14
1T	850805	21.5	80	50		1148
1T	850805	20.1	89	20		200
2T	850408	14.9	79	3		2
2T	850423	18.1	165		10	26
2T	850429	16.9	197			10
2T	850429	16	189			24
2T	850515	21	252			2
2T	850528	22.9	265	0		4
2T	850614	20	250	0		10
2T	850624	25	291	0		4
2T	850706	23.5	279	0		24
2T	850720	27	300	0		4
2T	850730	27	300	0		20
2T	850805	23	205	35		100
2T	850805	22.1	228	27		384
2T	850820	23.1	270	0		0
2T	850831	26	300	0		6
2T	850921	24	245	0		20
3T	850327	15	115			4
3T	850408	14.5	131	0		0
3T	850423	17.2	114		9	
3T	850515	16.2	208			4
3T	850528	20.5	210	0		42
3T	850614	17.5	189	0		14
3T	850624	22.9	248	0		24
3T	850720	25	300	0		4
3T	850820	22	279	0		22
3T	850831	23.9	280	0		8
3T	850921	24	279	0		6
4T	850327	16	240			16
4T	850408	14.5	235	4		8
4T	850423	17.9	229		8	312
4T	850515	23	301			2
4T	850528	22	290	0		6
4T	850614	24	292	0		0
4T	850624	28	310	0		4
4T	850720	29	325	0		10
4T	850730	29	320	0		0
4T	850820	24.5	310	0		4
4T	850831	23	315	0		8
4T	850921	20	220	0		2
5T	850327	16	115			0
5T	850408	14	118	3		6
5T	850429	17	148			90
5T	850515	23	180			2
5T	850528	22.5	202	0		14
5T	850614	24	185	0		4
5T	850624	29	228	0		10
5T	850715	30.5	231	0		0
5T	850730	30	249	0		6
5T	850820	24.9	228	0		16

5T	850831	27.9	231	0		4
5T	850921	21	215	0		6
6T	850411	15.5	150	0		6
6T	850423	17.1	113		9	190
6T	850515	21	195			6
6T	850528	22.5	202	0		2
6T	850614	23.8	230	0		4
6T	850624	27.2	251	0		2
6T	850715	29	231	0		10
6T	850730	29.9	272	0		0
6T	850820	24.1	265	0		0
6T	850831	26	249	0		4
6T	850921	22	235	0		12
7T	850410	13.3	250	0		16
7T	850422	16.3	281	0	8	14
7T	850424	19	265		10	22
7T	850513	17.9	298			8
7T	850529	20	320	0		26
7T	850612	21	338	0		18
7T	850628	17.7	325	0		150
7T	850719	25	401	0		14
7T	850731	27	390	0		12
7T	850821	17.2	330	0		0
7T	850922	18.9	350	0		28
7T	850901	22	370	0		66
8T	850410	13.8	140	0		10
8T	850422	17.7	169	0	7	12
8T	850513	19.7	192			12
8T	850527	22	209	0		30
8T	850612	25	228	0		2
8T	850628	24	245	0		12
8T	850731	30	262	0		20
8T	850821	26	232	0		6
8T	850901	27	245	0		0
8T	850922	22.5	220	0		16
9T	850410	14.9	69	0		6
9T	850422	16	85	0	10	30
9T	850513	20	100			78
9T	850527	20	122	0		44
9T	850612	24	149	0		2
9T	850628	24.9	270	0		
9T	850716	25	212	0		30
9T	850731	30	250	0		28
9T	850821	26.3	180	0		12
9T	850901	29.5	200	0		14
9T	850922	24	192	0		68
10T	850410	16	218	0		12
10T	850422	16.9	225	3	7	122
10T	850513	22	245			72
10T	850530	19.8	248	0		0
10T	850612	22.7	270	0		4
10T	850626	23	290	0		6
10T	850719	22	279	0		14
10T	850821	25.8	312	0		10
10T	850802	24	302	0		18
10T	850901	28	330	0		0
10T	850922	25	302	0		0
11T	850410	16.1	254	0		2
11T	850422	16	253	0	8	316
11T	850513	19.7	287			12

11T	850529	20	282			4
11T	850612	18.5	280	0		4
11T	850626	19.5	298	0		14
11T	850719	19	295	0		0
11T	850802	20	295	0		4
11T	850823	23.5	250	0		12
11T	850901	22.5	310	0		10
11T	850922	20.5	290	0		0
12T	850410	16.2	171	0		8
12T	850422	18	200	3	9	
12T	850513	23.2	215			26
12T	850527	23.9	238	0		22
12T	850612	21.9	238	0		48
12T	850626	27	280	0		44
12T	850719	26	270	0		28
12T	850804	25	250	0		4
12T	850822	26	240	0		20
12T	850902	27	255	0		14
13T	850410	15.5	250	0		12
13T	850422	16.5	260	15	7	358
13T	850513	19.9	300			2
13T	850527	20	300			0
13T	850612	19.5	300	0		4
13T	850626	22	330	0		16
14T	850424	17.5	238		9	62
14T	850517	23	285			114
14T	850530	19.8	290	0		78
14T	850619	21	310	0		88
14T	850626	26.1	320	0		12
14T	850716	25	320	0		14
14T	850802	25	320	0		12
14T	850821	24.5	315	0		24
14T	850412	15.9	255			32
14T	850902	24	315	0		24
14T	850922	23	310	0		14
15T	850412	17.8	218	0		2
15T	850425	18	209		12	8
15T	850517	20.9	258			6
15T	850531	22	255	0		0
15T	850609	23	255	0		0
15T	850628	25	275	0		12
15T	850716	28	271	0		2
15T	850804	24.8	249	0		12
15T	850823	26	250	0		0
15T	850920	23	255	0		16
15T	850902	27.5	260	0		2
16T	850412	15	230	0		4
16T	850425	16	210		10	12
16T	850517	19	220			6
16T	850531	19	270	0		0
16T	850609	22	302	0		6
16T	850628	22.5	310	0		7
16T	850723	24	295	0		0
16T	850804	21	290	0		60
16T	850823	23.9	302	0		6
16T	850920	21	280	0		4
16T	850902	22.5	300	0		2
17T	840412	18.9	329	0		14
17T	850425	16.9	318		11	58
17T	850517	22.9	379			4

17T	850531	25	385	0	0
17T	850609	28	420	0	2
17T	850628	26.2	395	0	21
17T	850723	30	400	0	20
17T	850804	24.5	345	0	20
17T	850823	31	400	0	0
17T	850902	30.5	415	0	40
17T	850920	24.5	360	0	16
18T	850519	18	242		6
18T	850618	22.5	252	0	0
18T	850723	26	245	0	2
18T	850816	25.1	228	0	0
18T	850914	20.5	240	0	14
19T	850518	15	309		110
19T	850617	21.5	179	0	10
19T	850712	24	360	0	8
19T	850815	25	350	0	2
19T	850913	20.1	330	0	48
20T	850722	14	225	0	2
20T	850815	22	292	0	122
20T	850913	19	322	0	14
21T	850722	21	355	0	14
21T	850815	23	360	0	6
21T	850913	19	350	0	8
22T	850527	19	250	0	0
23T	850618	19.5	305	0	46
23T	850723	23	375	0	14
23T	850816	23	362	0	28
23T	850914	18.1	348	0	8
24T	850519	16.5	305		6
24T	850618	21	275	0	108
24T	850723	25	340	0	12
24T	850816	23	325	0	4
24T	850914	20	315	0	40
25T	850618	21	390	0	20
26T	850618	18	398	0	2
26T	850723	21	425	0	14
26T	850816	21	370	0	20
26T	850914	19.5	330	0	162
27T	850519	18.4	362		6
27T	850618	20	390	0	12
27T	850723	24.5	450	0	10
27T	850816	21.5	362	0	10